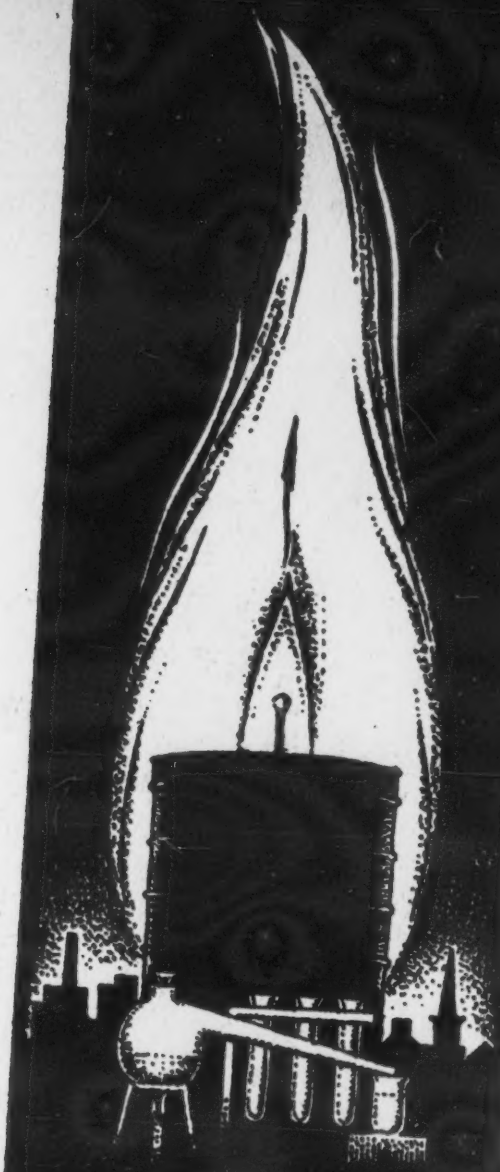

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GAS ABSTRACTS

GAS ABSTRACTS was started in 1945 by the Institute of Gas Technology to survey current technical journals, to select articles pertaining to the Gas industry, and to prepare abstracts of these articles, stressing their significance to the Gas Industry.

Selection of Articles: Each month the periodicals listed on the last two pages are examined and articles pertaining to the production or manufacture, distribution, transmission or storage, and utilization of natural and manufactured gas and related subjects are selected for abstracting by individual staff members of the Institute of Gas Technology. When possible the significance of the article to the Gas Industry is stressed.

Classification of Abstracts: The abstracts are grouped under twelve headings for presentation and are arranged alphabetically by subject in each group. The headings and subject matter included in each are presented below:

1. The Gas Industry will include general information and news items, statistics, business regulations and other articles of general interest.

2. Appliances - Domestic and Commercial will include burners, ranges, cooking equipment, air conditioning equipment, water heaters and other gas appliances for domestic and commercial use.

3. Combustion and Industrial Furnaces will include combustion of gaseous, liquid and solid fuels; design of industrial furnaces; control of furnace atmospheres.

4. Carbonization and Gasification will include manufacture and purification of producer gas, blue gas, carburetted water gas, synthesis gas; carbonization and gasification of coal; and gasification of oil.

5. Natural Gas and Natural Gas Condensates will include production, transmission, distribution and storage of natural gas and natural gas condensates; distribution of LP-gas mixtures; carbon black and chemicals from natural gas and natural gas condensates.

6. Petroleum and Synthetic Liquid Fuels will include production, refining-cracking, alkylation, isomerization, and utilization of petroleum and production of synthetic liquid fuels by the Fischer-Tropsch reaction and hydrogenation.

7. Analytical Methods and Tests will include new and improved methods pertaining to gas making materials, processes, products, and by-products.

8. General and Physical Chemistry will include data on chemical and physical properties of elements and inorganic compounds; new reactions; and methods for carrying out established reactions.

9. Organic Chemistry will include data on organic compounds closely related to the Gas Industry; new reactions; new methods for carrying out established reactions.

10. Chemical Engineering will include data and methods for fluid flow, heat transfer, and unit operations of distillation, evaporation, extractive drying, and filtration.

11. Process Equipment and Instrumentation will include information on new equipment for process operations and process control.

12. Materials of Construction will include new developments in refractories, heat and corrosion resistant materials, new alloys applicable to the Gas Industry, and other materials of construction.

13. New Books will include recent books pertaining to the field of gas technology.

Annual Index: Author and subject indexes will be issued at the end of the year.

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NATURAL GAS CONSERVATION PLANS

SUN OIL COMPANY TO CONSERVE NATURAL GAS. *Chem. Eng. News* 24, 928 (1946) *April 10.*

A $4,000,000 program to conserve natural gas has been launched by Sun Oil Co., and will involve the construction of nine processing plants, James E. Pew, manager of the company's natural gas and natural gasoline division, has announced. More than 65,000,000 cubic feet of gas daily will be conserved by the program. In addition, the company plans to gather and sell from 5,000,000 to 6,000,000 cubic feet daily of waste flare gas in the Beaumont, Texas area. Construction of the principal plants in the program will go forward immediately in Texas, Louisiana, and Michigan. A natural gasoline plant, and possibly a gas storage compressor plant, is scheduled for construction in the Sun and North Sun Fields in South Texas, involving an expenditure of about $1,000,000. The company is joining other operators in the Seeligson Field, South Texas, in constructing a gas cycling and natural gasoline plant, in which Sun's investment will amount to slightly more than $2,000,000. Work has already started on two of four small pressure-maintenance plants in other South Texas fields. In Michigan, a pressure-maintenance plant costing about $125,000 will be built, and in Louisiana plans for a natural gasoline plant in the Delhi Field are being developed.

SYNTHETIC FUELS

PRIVATE CONCERNS TO EVALUATE SYNTHETIC FUELS PROCESSES. *Chemical Industries* 58, 651 (1946) *April.*

Broadened interest in the potential use of coal as a basis for the production of synthetic liquid fuels can be inferred from the recent disclosure that Pittsburgh Consolidation Coal Co. is planning to join Standard Oil Development Co. in the inauguration of a major privately-financed, research program to investigate the carbonization and complete gasification of coal. In the proposed merger of research endeavors, Standard Oil Development Co., a subsidiary of Standard Oil Co. (N.J.), will contribute its technical knowledge of petroleum-based processes for the manufacture of high octane fuels. Pittsburgh, with its 43 mines in Pennsylvania, West Virginia, and Kentucky, producing 20 million tons of coal annually, will broaden its own research activities at the company's Disco unit, near Pittsburgh.

--Excerpt from article

2. APPLIANCES - DOMESTIC AND COMMERCIAL

BURNERS

Dunning, E.W. THE DESIGN OF GAS COOKER HOTPLATES. *Gas World* 124, 302-306 *(1946) March 16.*

Comparative utilization efficiencies are given for several types of stove top burners at various loads. Ring burners, Meker burners, spreading-flame burners, and luminous-flame burners were studied. The effects on utilization efficiency of pan size, distance from flame, and other factors are discussed.

--M.F. Knoy

BURNERS

FUNDAMENTAL DATA FOR DESIGN OF TOTALLY AERATED ATMOSPHERIC GAS BURNERS. *Am. Gas Assoc. Testing Laboratories Research Bulletin* 38, *1-16 (1946) January.*

Behavior of fast-burning gases at elevated temperatures is presented. Flash back limits of various gases are graphically shown. Data are given which illustrate effects of port depth, port spacing and port size on the flask-back limits of city gases. In addition a theory is presented to explain the cause of flash-back, and a portion of the data compiled is interpreted in light of this theory. Burners designed to inject all air for combustion as primary air are also discussed.

--Author's Abstract

GAS INTERCHANGEABILITY

INTERCHANGEABILITY OF OTHER FUEL GASES WITH NATURAL GASES. *Am. Gas Assoc. Testing Laboratories Research Bulletin* 36, *1-75 (1946) February.*

Data are presented covering performance of appliances initially adjusted on natural gases when various types of supplemental gas mixtures of heating values greater than 800 Btu are employed. Effects of such substitution are considered for 3 separate adjustment gases which are representative of all natural fuel gases distributed within the United States; namely, (1) 1115 Btu., 0.64 sp. gr. high heating value (over 1100 Btu) natural gas, (2) 959 Btu, 0.558 sp. gr. high methane (over 90 per cent) natural gas, and (3) 1000 Btu, 0.693 sp. gr. high inert (over 10 per cent) natural gas. Derivation and application of mathematical equations for establishing interchangeability limits for lifting, flash-back, and yellow tips with natural gas employed as the adjustment gas, are outlined. Gas interchangeability calculation sheets are given in complete form to provide operators with a quick and ready means of obtaining the interchangeability indices. Gases may be evaluated directly by use of the calculation sheets without previously having a thorough knowledge of the text content. Data are presented which were obtained from contemporary flame characteristic test burners and the steps that were taken toward development of a burner to provide a visual means of maintaining desired characteristics in send-out gas are shown in the bulletin appendix.

--Author's Abstract

2. APPLIANCES - DOMESTIC AND COMMERCIAL

HEAT ABSORPTION IN OVENS

FUNDAMENTALS OF HEAT ABSORPTION BY UTENSILS IN GAS RANGE OVENS. *Am. Gas Assoc. Testing Laboratories Research Bulletin* 39, *1-25 (1946) January.*

Quantitative data are presented to show the amount of heat absorbed by various kinds of utensil finishes and different sizes of utensils. Effects of oven interior finish on speed and efficiency of oven cooking are discussed. Relative percentages of radiant heat and convected heat utilized by utensils at different oven temperatures are shown. Analysis is made of the effect of oven loading on amount of heat absorbed, oven maintaining rate and temperature of interior oven walls. As a result of this investigation it appears that the most effective and efficient oven designs are usually those which have a black bottom finish with chrome plated sides, and are constructed to permit passage of flue gases through the oven. However, when utensils fill a large volume of the oven space, use of black oven walls serves to increase rate of heat absorption appreciably. It also appears that most effective types of oven utensils are those with large bottom areas and with glass or dark (high heat emissivity) surfaces.

—Author's Abstract

RADIANT HEAT BURNER

RADIANT HEAT BURNER FOR USE ON SOLID TOP RANGES. *Gas J.* 247, *142-143 (1946) January 23.*

Construction details of a heavy duty radiant heat burner are given. It is especially suited to solid-top commercial ranges, and is said to give a high efficiency of utilization.

—M.F. Knoy

STEAM COOKER

NEW FOURTH ZONE COOKER. *Am. Gas Assoc. Monthly* 28, *156-158 (1946) April.*

The Fourth Zone Cooker uses steam at one pound pressure as the heat transfer and temperature control medium. The device consists essentially of a steam tight oven set over a gas fired steam generator. The food being heated is exposed directly to live steam. This steam cooker has been found to be ideal for cooking puddings, cereals, fruits and vegetables. Frozen foods respond particularly well to this method of cooking. It is claimed that there is less dissipation of valuable vitamins and minerals from foods cooked this way, and that drying out and oven heating are eliminated. This equipment is now undergoing field tests and should be commercially available in the near future.

—M.F. Knoy

3. COMBUSTION AND INDUSTRIAL FURNACES

ATMOSPHERE GENERATOR

GAS CRACKING UNIT PROVIDES PROTECTIVE ATMOSPHERE. *Industrial Gas* 24, 24 *(1946) April.*

A brief description is given of a protective atmosphere generator. It consists of a nickel alloy retort filled with porous refractory cubes impregnated with catalyst. The retort is set in a furnace and fired externally at a temperature of 1830° F. A mixture of air and gas is fed in at the bottom and the cracked gases drawn off at the top.

—M.F. Knoy

CHROMITE ORE REDUCTION

Boericke, F.S. SELECTIVE REDUCTION OF IRON IN CHROMITE BY METHANE-HYDROGEN AND SIMILAR GAS MIXTURES. *U.S. Bureau of Mines. R.I. 3847 (1946) February.*

Continuous reduction of chromite ore with methane-hydrogen mixtures was studied in more than 60 small-scale tests under as carefully controlled conditions as was permitted by the small equipment used. Results of these tests may be summarized as follows: Enough iron was rendered acid-soluble by gaseous reduction of chromite at temperatures below 1,100° to produce acid - leached residues that meet "high-grade" specifications. The rate of reduction by methane is extremely high, as evidenced by the fact that in all tests gas remained in contact with hot ore for less than 1 second. Gas mixtures containing less than 25 percent methane gave the best and most rapid reduction of iron. High utilization of methane was obtained under carefully selected conditions. Furnace exit gas, after reaction with chromite, consists largely of hydrogen and carbon monoxide and presumably could be used both for diluting fresh input methane and for fuel to supply all the heat necessary for the reduction furnace. Preliminary but inconclusive tests indicated that untreated natural gas reduced chromite at rates and efficiencies comparable with purified methane. Comparison between solid and gaseous reducing agents appears to favor solid reductant for the production of the highest-grade product but favors gaseous reductant with regard to (a) temperature of reduction, (b) rate of reaction, (c) cost of reducing agent plus fuel, and (d) materials of furnace construction. Methane-hydrogen mixtures gave better chromite reduction than was obtained in any of the incomplete tests with liquid reagents.

HIGH INTENSITY AIR-GAS BURNER

Palser, J. THE CONCENTRATED COMBUSTION BURNER. *Gas Times* 45, 38-43 *(1945) November 24.*

The author describes the development of a high intensity air-gas burner. It consists essentially of a high grade refractory tube supplied with combustible mixture through co-axial metal spud, cemented into the tube at one end. The tube is of sufficient length to permit complete combustion before the gas emerges. Very high combustion rates, on the order of 25 therms per cu. ft. of tube volume, are claimed. The resulting high temperature jets of flue gas are effective for quick, localized heating as required for such uses as billet heating, belt heading, tube annealing, etc. The burners are arranged in banks or nests as required for the various applications.

—M.F. Knoy

3. COMBUSTION AND INDUSTRIAL FURNACES

HIGH SPEED HEATING

Hess, F.O. HIGH-SPEED GAS HEATING. *Am. Gas Assoc. Monthly* 28, 149-152 (1946) *April.*

The purposes and advantages of high speed heating are set forth. The advantages of gas for this purpose are operating economy and accurate automatic control. Several automatic heat treating arrangements are described, and the possibility of extending high speed gas heating into other fields is indicated.

--M.F. Knoy

IMMERSION TUBE HEATING

Eeles, C.C. HEATING BY IMMERSION AND SUBMERGED COMBUSTION. *Am. Gas Assoc. Monthly* 28, 179-181 (1946) *April.*

The value of immersion tube heating for heating solution tanks is pointed out. It is in common use for cleaning, rinsing, fluxing, coating metals, and other industrial uses. Its advantages are simplicity of installation, flexibility, and high operating efficiency. Formulas are presented for determining the optimum tube surface area, tube size and length, etc. for various load requirements.

--M.F. Knoy

SMOKE

Cave, G.A. DUSTS AND SMOKES IN FLUE GASES. *British Coal Utilization Research Assoc. Monthly Bull.* 10, 61-98 (1946) *March.*

Flue dust is derived from unburnt carbon and from the inorganic mineral constituents of the coal used. The most important constituents are those which affect ash fusibility (silica, iron oxide, calcium oxide, alumina) and those which are responsible for volatile products (alkalies, arsenic, sulfide, phosphates, etc.). The release and formation of dust depends on chemical reactions, volatilization and mechanical pick up. The extent to which released alkalies condense depends on the rate of cooling and the availability of surfaces. Temperature, position in the fuel bed and manner of firing are of prime importance in dust release. The chemical analysis of fly ash varies with particle size, being higher in carbon the larger the particle size is. The dust concentration in a flue gas depends on local conditions of gas movement, thermal gradients, proximity to surfaces and the relations between particle size, and velocity and direction of the gas stream. Smoke coagulation is greater the finer the particle size and the greater the spread in particle sizes. Geometrical factors are also of significance. Destruction of boiler tubes is laid to erosion by solid particles and corrosion by CO_2, SO_2 and SO_3. An extensive bibliography is included.

--J.D. Parent

4. CARBONIZATION AND GASIFICATION

CARBONIZATION

Gibson, J.W. MODERN METHODS OF CARBONIZATION. *Gas J.* 246, 884-6 (1945) *December 19; Gas Times* 45, 29-31 (1945) *November 24.*

The operation of the Burns-Gibson type plant for the complete gasification of coal in a single stage is described. The objective is the production of gas of standard calorific value in one automatic operation. By direct application of heat the spaces occupied by the walls and flues of a vertical retort installation are avoided, eliminating their expensive upkeep. With less ground space, the capital outlay per therm produced is reduced. The plant being automatically operated by remote controls, labor, other than the cleaning of the fires, is practically eliminated. The weight of solid material handled per therm is 40% of that for the two-stage process. The out-standing features of the process are: (1) Simplicity in design and operational details; (2) Flexibility in gas production; (3) Flexibility to allow gasification of varying qualities of fuel; and (4) Carburetting in the fuel bed itself by means of the tar produced in the process.------- The Burns-Gibson type plant is actually a development of the Pintsch process which has been in successful operation in Europe for a number of years. It consists of a retort superimposed upon a water gas generator in such a way that the blow gases pass through an annulus surrounding the retort. The blast gases, burned in a waste-heat boiler, provide the necessary steam for the process, and the combustion products preheat the tar used for the enrichment. During the blast period partial carbonization takes place in the superimposed retort, the highly reactive semi-coke formed, passing into the water-gas zone, being steamed during the run period.for the production of water-gas. The mixture of steam and tar vapors is preheated in its travel through the annulus surrounding the retort, before passing to the inlet at the base of the water-gas zone. The tar, passed through the fuel bed at a temperature higher than that of its formation, cracks into hydrocarbon gases which enrich the blue-gas formed. Further enrichment takes place as the gas is forced to pass through the carbonization zone. A salient feature of the plant is a very efficient "hanging bar" type of grate which increased the gasification area and eliminated all clinkering troubles. In larger plants mechanical ash removal can be incorporated.-------The production cost depends upon the heating value of the gas produced. Translated to dollars and cents (on the basis of $4.80 exchange value for the British pound), the production costs are 52.2, 54.8 and 55.4 cents per Mcf of 400, 425 and 430 Btu gas made, respectively. The production costs per therm (100,000 Btu) of gas made are 13.0, 13.6 and 13.8 cents, respectively.

--J.J.S. Sebastian

CARBURETTED WATER GAS MANUFACTURE

Bate, J.B. GASEOUS FUELS-II. THE MANUFACTURE OF CARBURETTED WATER GAS. *Petroleum* 9, 52 (1946) *March.*

It is often economical to meet peak load requirements by the use of carburetted water gas plant rather than by the use of additional carbonizing plant. The total volume of carburetted water gas made in Britain comprises about 10-15% of the total city gas sold. The advantages of carburetted water gas compared with coal gas are: lower capital cost, less space occupied, no by-product plant required, and the wear and tear

costs are about one-third of those of carbonizing plants.-------When steam is blown through hot coke, above 1850° F the following reaction occurs almost exclusively: $C + H_2O = CO + H_2$; below 1100° F this reaction is negligible and the reaction taking place is: $C + 2H_2O = CO_2 + 2H_2$. Between these temperatures the reactions proceed simultaneously. Blue gas burns with high heat release and is used in welding and for heating metallurgical furnaces. It is a source of hydrogen and is used also in synthetic processes.-------Carburetted water gas is the product of the enrichment of blue gas with petroleum oil cracked in the checker-work chambers of the carburettor and superheater of standard water gas sets. As a result, the gas thus made contains about 8% olefin and about 9% paraffin hydrocarbons, in addition to about 5% Co_2, 34% CO and 39% H_2; the heating value is about 500 Btu.-------The operation of standard water gas generators is subsequently described.-------The thermal balance of the process depends upon the plant, the method of operation, and the calorific value of the gas to be made. For a gas of 485 Btu, using 1,854 gal. of oil per Mcf of gas made, the calorific value of the carburetted water gas is about 60% of the total thermal input of the plant. Of the remainder about 19% leaves the plant as sensible and potential heat of the blow gas, 4% as the sensible and potential heat in the clinker and ash, 5% of the sensible heat in the gas made, 7% as sensible and potential heat in the tar, 2% as heat in undecomposed steam, and about 4% is the amount of heat lost by radiation, etc.

--J.J.S. Sebastian

GASEOUS FUELS

Bate, J.B. GASEOUS FUELS---I. GENERAL REVIEW. *Petroleum* 9, 26 (1946) *February*.

A comprehensive review is given of the various types of gaseous fuels manufactured or found in nature. The characteristics and uses of each fuel gas are enumerated. Coal gas is made in Britain in (a) horizontal retorts; (b) continuous vertical retorts; and (3) by low temperature carbonization. The oldest of these types is the horizontal retort which operates intermittently at a temperature of about 2450°F., yielding a 560 Btu gas of about 0.40 specific gravity. The continuous and intermittent vertical retorts operate at 1850-2100° F, but due to a certain proportion of steam introduced, a 475 Btu gas is obtained with a specific gravity of about 0.48. The gas made in the vertical retorts is of more uniform composition; and a higher tar yield is obtained than in the horizontal retorts. The tar is of lower specific gravity and contains less free carbon. The gas obtained by low-temperature carbonization at 1000-1400°F is high in hydrocarbons, containing about 5.5% olefins and 52.0% paraffins, and therefore has a high heating value of about 890 Btu, with a specific gravity of 0.62. Coke-oven gas is similar in composition to that obtained in horizontal retorts, having a calorific value of about 525 Btu, and a specific gravity of 0.38. Natural gas is used both as a fuel and as a chemical raw material, a typical heating value being about 1010 Btu with a specific gravity of 0.69. Oil gas is the product of cracking petroleum oils, the composition varying according to the temperature used, proportion of steam added and feed stock gasified. A typical oil gas contains about 3% CO_2, 3% olefins, 11% CO, 53% H_2, 27% paraffins, and has a calorific value of about 535 Btu, with a specific

gravity of 0.39. Producer gas results from the reduction of CO_2 to CO and, in most cases, also from the decomposition of added steam to CO and H_2. Many types of producers are used commercially, such as updraft, downdraft, suction, pressure, hand fired or mechanically fired; poking and ash removal are performed either by hand or mechanically. A typical producer gas has a heating value of about 132 Btu, and a specific gravity of 0.90. Blast furnace gas is the by-product of the production of pig iron, the composition being similar to that of producer gas except that it is made in the absence of steam; heating value: about 92 Btu; specific gravity: 1.01. Water gas is the product of the reaction between steam and coke at a temperature of about 2500° F., the "blue gas" having a heating value of about 295 Btu and a specific gravity of 0.55. The corresponding figures for a typical "carburetted water gas" are: 500 Btu and a specific gravity of 0.63.

--J.J.S. Sebastian

GASIFICATION

Weir, H.M. THE HIGH PRESSURE GASIFICATION OF COAL. *Abstracts 109th Meeting Am. Chem. Soc. April 1946, p. 5G-6G.*

Continuous, rather than intermittent production of city gas, directly from solid fuel and at high pressure was in commercial operation in at least two plants in Germany during the war period. The Lurgi Gesellschaft has developed the process, largely in prewar days. The first commercial installation was at Bohlen, Saxony, and from late 1939 or early 1940 it supplied part of the gas from the nearby city of Leipsig. A second plant in Silesia started operations at a later date. At Bohlen, the A.S.W. (Aktiengesellschaft Sachsiche Werks) used fuel in the form of roughly sized fragments of briquets from low temperature carbonization of Braunkohl. Braunkohl, after drying and sizing, was itself often mixed in with the other fuel. The 1 to 2 meter deep fuel bed in the generator was continously blasted with a mixture of steam and oxygen, the latter produced by a nearby Linde-Frankl plant. The crude gas resulting contained some 30% carbon dioxide and was under some 18 atmospheres pressure. Appropriate cooling, removal of tar and distillate, followed by other purification under pressures produced gas under 18 atmospheres pressure and typical analysis: Hydrogen 48-49%; carbon monoxide 22-24%; methane 25-29%; remainder, higher hydrocarbons, nitrogen and carbon dioxide; heating value 4200-4300 K cal/nM^3. Details of the construction of the equipment and typical operation are given in the paper.

--Excerpt from author's abstract

HEAT RECOVERY

King, J.G. and Dent, F.J. UTILIZATION OF WASTE HEAT IN THE CARBONIZING INDUSTRIES. *Gas J. 247, 435-437 (1946) March 13.*

Systems of heat recovery have attained a high level of efficiency in Britain, both for gas works and for coke oven plants. In the gas-works, recuperation or regeneration must be limited to the heat exchange between exit gases from the combustion chambers and secondary air introduced. Waste-heat boilers are often used in addition. In the coke industry, whether the ovens are heated by part of the gas made or by blast furnace

gas, the heat recovery in regenerators is so complete that further recovery by waste heat boiler is impracticable.-------In the British gas industry in 1938, about 28% of the city gas supply was made in horizontal retorts, 48% in continuous vertical retorts, 12% in intermittent vertical retorts, 2% in coke ovens and 10% in water-gas plants. (1) In the horizontal retorts, the heat is recovered from waste gases by recuperators with or without waste-heat boilers. (2) In modern continuous vertical retorts, only waste-heat boilers are used, but in the (3) intermittent retorts recuperators and waste heat boilers are still employed. (4) For coke ovens, regenerators fired with producer gas are used. (5) In water-gas plants, the heat from waste gases is recovered in waste heat boilers, air being added before the boiler to complete combustion.-------The authors subsequently discuss the thermal efficiencies of these five types of gas producing systems, without and with proper waste-heat recovery in each case.

—J.J.S. Sebastian

5. NATURAL GAS AND NATURAL GAS CONDENSATES

CYCLING

Pratt, A.W. THE ERATH CYCLING PROJECT. *Gas* 22, 37-40 *(1946) April.*

Tne Erath Plant in Southern Louisiana is one of the largest cycling plants in the world, particularly in regard to liquid products. The design pressure of 2000 psi for the absorbers and 5000 psi for the injection gas compressor discharge is unusual. Provision for the production of high purity light liquefied products is in accordance with recent trends in their utilization. Utilities are carefully balanced to give maximum thermal efficiency and complete independence from outside power sources. The Erath project demonstrates the ideal development of a natural resource wherein unitization insures a coordinated plan of exploitation with no waste. After the liquid products have been removed, there will remain a large volume of high pressure gas available for future utilization.

—Author's Abstract

GAS METERING

Wilson, G.M. GAS METERING AT FULL LINE PRESSURE. *Oil Weekly* 121, *28-29 (1946) April 1.*

A unique installation is described wherein well pressure is maintained, but water is removed before metering. Hydrate formation is avoided by warming the gas as it comes from the well and then subjecting to high pressure scrubbing and trapping to remove water. The gas from each well is treated separately.

—J.D. Parent

HYDRATE STORAGE

Miller, B. and Strong, E.R., Jr. HYDRATE STORAGE OF NATURAL GAS. *Am. Gas Assoc. Monthly* 28, *63-67, 92 (1946) February; Proceedings of American Gas Association, Natural Gas Dept., 1946 (Preprint).*

A method for determining the ratio of hydrocarbon to water in a solid hydrate of a normally gaseous hydrocarbon and its application to propane hydrate. The formula for propane hydrate is given as C_3H_8 , $6H_2O$. The decomposition pressure-temperature relationship for propane hydrate in equilibrium with propane vapor and liquid water is given. Also, the article contains a chart for obtaining the fugacity of propane vapor in low temperature and pressure regions from pressure and temperature data.

—E.R. Strong, Jr.

LP-GAS SPECIFICATIONS

TENTATIVE SPECIFICATIONS AND TENTATIVE STANDARD METHODS OF TEST FOR LIQUEFIED PETROLEUM GASES. *California Natural Gasoline Assoc. Bulletin No. TS-441 (1945).*

This bulletin describes and defines the composition of liquefied petroleum gases, classifies these liquefied gases into grades, and presents tentative standard methods of tests for identifying, grading, and handling these products. These tentative standard procedures are presented in Part II of the bulletin.

5. NATURAL GAS AND NATURAL GAS CONDENSATES

NATURAL GAS RESERVES

Wiess, H.C. NATURAL GAS. *Natural Gases 1946, 7-11 March.*

The Texas and Louisiana Gulf Coast, comprising a strip about 100 miles wide extending some 700 miles from Brownsville to New Orleans, has come in recent years to occupy an important position in the natural gas reserves of the United States. Probably no other equivalent area in this country contains such a store of buried treasure in the form of oil and natural gas. The Gulf Coast now has proved reserves of over 45 trillion cubic feet of gas and 6 billion barrels of oil, representing 30 per cent of the reserves in the United States, which are about 150 trillion cubic feet of gas and 20 billion barrels of oil. The great reserves of this coastal area help to explain the fact that Texas and and Louisiana have about 70 per cent of the nation's oil and gas resources.

---Excerpt from article

PROPANE RECOVERY

Bell, F.M. INCREASING PROPANE RECOVERY IN EXISTING NATURAL GASOLINE ABSORPTION PLANTS. *Natural Gases 1946, 15-18 March.*

Increased requirements for butane for war purposes has caused a corresponding increase in propane recovery for many uses formerly filled by butane. Mr. Bell discusses herein methods by which propane recovery may be increased in existing gasoline absorption plants without reducing recovery of butane. He suggests and discusses the following methods: (1) Increased extraction of propane in the absorber by increasing molal oil gas ratio, by using a lighter oil giving more mols per gallon of oil circulated, or increasing actual volumetric pressure rate. (2) Decreasing equilibrium constant, by increasing pressure (impractical in most existing plants), and reducing absorption temperature by refrigeration applied to lean oil and rich gas, and deethanizer over-head. (3) Use of stabilizer bottoms recycle to the still final condenser. (4) Use of the deethanizer control method.

---Editor's Summary

STORAGE

Boardman, H.C. STORAGE OF VOLATILE PETROLEUM PRODUCTS. *Petroleum Refiner* 25, *109-116 (1946) April.*

This very comprehensive article begins with definitions of basic concepts of evaporation and vapor pressure, outlines the problem of storage and filling losses and factors affecting the same, and proceeds to describe the different methods of preventing these losses. Equations and graphs are given for filling and storage losses from vessels of the three general types: 1) liquid-volume-change tanks, where the retaining surfaces are always kept in contact with the liquid, such as floating roof tanks; 2.) vapor-volume-change tanks capable of adjusting themselves to varying vapor volumes, either at constant or variable pressure such as tanks equipped with breather or balloon or lifter roofs and 3.) pressure-change tanks which are able to keep the combined liquid and vapor volume constant by withstanding internal pressures developed under storage conditions. Examples of the latter class are conventional storage tanks with vertical cylindrical shells, flat bottoms, coned or domed

roofs and conservation vents, effective up to a very small pressure and spheroids, spheres, and blimps or bullet tanks, effective over large pressure ranges. The author concludes with hints on tank design and outlines his opinions on trends in tank construction.

—J.J. First

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

CATALYSTS

Evans, L.P. COMPARISON OF BEAD AND CLAY CATALYSTS. *Oil & Gas J.* 44, 167-183 *(1946) March 30.*

Synthetic bead catalyst has been found to produce 4-8% more gasoline compared with natural clay catalyst in the Thermofor catalytic cracking (T.C.C.) process. In addition, the bead catalyst retains its activity longer, gives a slightly better gasoline product and its efficiency is not affected by charge stocks high in sulfur and nitrogen compounds. The cost of synthetic catalyst is higher ($240 against $100 per ton on a dry basis) but economic analysis for various operating conditions indicates additional revenues in favor of the bead catalyst of $500 to $2000 per day for a 10,000 barrel per day T.C.C. plant.

--C.H. Riesz

LIQUID FUELS

Alden, R.C. CONVERSION OF DRY NATURAL GAS TO LIQUID FUEL. *World Petroleum* 17, 46-49 *(1946) April.*

The conversion of dry natural gas to liquid fuels by means of the Fischer-Tropsch process is discussed in regard to its history, reaction conditions, nature of products and costs. Whereas it has been considered uneconomic in the past, private industry is studying the process intensively and large scale operations are currently being planned. The Bureau of Mines is working on the process from the long range aspect, that is, the production of liquid fuels will ultimately have to employ coal as the starting material. Knowledge gained from the conversion of natural gas will be directly applicable to the synthesis of liquid fuels from coal. Other processes for converting natural gas to liquid hydrocarbons are mentioned briefly.

--C.H. Riesz

NON-PETROLEUM FUELS

Duck, J.T. and Bruce, C.S. UTILIZATION OF NONPETROLEUM FUELS IN AUTOMOTIVE ENGINES. *J. Research National Bureau Standards* 35, 439-465 *(1945) December.*

A number of substitute fuels and blends were tested to determine their relative efficiency in the operation of common types of engines. The tests showed that the maximum power developed with alcohol and with some of the other fuels was slightly greater than with gasoline. The specific fuel consumption with the various fuels was approximately in inverse proportion to the heat of combustion of the fuel used. Analysis showed that the mixture distribution was less uniform with the substitute fuels than with gasoline. Tests made with low-proof alcohols showed that an engine can be operated on blends as low as 70 proof, but it is ordinarily impractical to use a blend much below 190 proof because of the excessive volume required.

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

PETROLEUM DESULFURIZATION

Reed, R.M. DESULFURIZATION OF PETROLEUM HYDROCARBONS. *Oil & Gas J.* 44, 219-226 (1946) *March 30.*

A number of organic sulfur compounds are found in petroleum and natural gas, either naturally or as result of processing changes made in the natural material. Eleven processes for removing hydrogen sulfide from hydrocarbon materials are discussed here, including the old Seaboard process, Thylox, Girbotol, and others. Mercaptans may be removed by oxidation to disulfides which does not lower the total sulfur content; or by processes such as Solutizer, Mercapsol, Unisol, caustic, etc. Gray, Houdry, and Perco processes remove sulfur compounds catalytically, as does the Union cobalt molybdate process, the last named developed especially for very high-sulfur-oil treatment.

--Author's Abstract

PETROLEUM REFINING

CYCLOVERSION. *Oil & Gas J.* 44, 136-166 (1946) *March 30.*

Flow diagrams, operating conditions and typical yield and product inspection data are presented for various catalytic refining processes. The following are included- Cycloversion catalytic cracking, fluid catalytic cracking, Houdry catalytic cracking, suspensoid catalytic cracking, thermofor catalytic cracking, hydroforming, HF alkylation, sulfuric acid alkylation, isomerization, desulfurization, polymerization.

--C.H. Riesz

POLYMERIZATION

Armistead, G., Jr. NONSELECTIVE CATALYTIC POLYMERIZATION HAS IMPORTANT POST-WAR UTILITY. *Oil & Gas J.* 44, 131-136 (1946) *April 6.*

As much as nearly 5 per cent of the total crude charged to a thermal or catalytic cracking unit may be recovered as high-octane-number propylene and butene polymers by the use of one of three catalytic polymerization processes. These processes include the phosphoric acid process of Universal Oil Products Co., the copper pyrophosphate process of Polymerization Process Corp., and the silica-alumina process of Phillips Petroleum Co. Catalytic-cracking processes yield lower percentages of C_2 and lighter products in the gases from the cracking operation, therefore the total columetric capacity of polymerization units operating on such tail gases need not be as large as those used for processing thermal cracking process gases. Nonselective polymerization is generally chosen because of its greater total yield, its lowest total investment and quickest economic payout.

--Author's Abstract

7. ANALYTICAL METHODS AND TESTS

FOULING TEST FOR IRON OXIDE

Pyke, H.G. THE DEVELOPMENT OF THE "A.G.L." FOULING TEST FOR IRON OXIDE. *Natl. Gas Bull. 9, 5-10 (1946) Jan-Feb.*

Low activity and capacity of certain batches of iron oxide used in the dry purification of gas prompted an endeavor to discover the reasons for poor performance. At the same time a research program was initiated to develop specifications for the evaluation of new oxide shipments because the standard fouling tests reported in the literature were found to be unsatisfactory for accurate control measurements. Details regarding the development of an improved, "A.G.L.", method are given along with a comparison of experimental results obtained in applying the "A.G.L." method and various other analytical methods to several oxide samples.

--H. Hakewill

OXYGEN DETERMINATION

Cohn, G. RECORDING INSTRUMENT FOR LOW CONCENTRATIONS OF OXYGEN IN GASES. *Abstracts 109th Meeting Am. Chem. Soc. April, 1946, p. 4L - 5L.*

An instrument is described for continuous detection and determination of small concentrations of oxygen in gases based on the measurement of the heat of the catalytic reaction between oxygen and hydrogen. The most useful concentration range is 0.001 to 0.2% by volume, but somewhat larger concentrations may also be determined. The catalyst used is active at room temperature. A given standardization of the instrument can be maintained even if the catalyst activity changes over larger periods of time. Determinations can be made in neutral atmospheres like H_2, N_2, CO_2, CH_4, C_3H_8, etc., or in mixtures of these gases making possible analytical control in the production or in the processing of such atmospheres. In combination with a recording or nonrecording controller the instrument can be applied to process control. Small concentrations of hydrogen may likewise be determined with the instrument.

--Author's Abstract

9. ORGANIC CHEMISTRY

ACETYLENE HYDROCARBONS, THERMODYNAMIC PROPERTIES

Wagman, D.D., Kilpatrick, J.E., Pitzer, K.S. and Rossini, F.D. HEATS, EQUILIBRIUM CONSTANTS, AND FREE ENERGIES OF FORMATION OF THE ACETYLENE HYDROCARBONS THROUGH THE PENTYNES, TO 1,500°K. *J. Research Natl. Bureau of Standards* 35, 467-496 *(1945) December.*

Values are presented for the following thermodynamic properties for acetylene, propyne (methylacetylene), 1-butyne (ethylacetylene), 2-butyne (dimethylacetylene), 1-pentyne (n-propylacetylene), 2-pentyne (methylethylacetylene), and 3-methyl-1-butyne (isopropylacetylene), in the gaseous state, to 1,500°K: The heat-content function, $(H°-H°_0)/T$; the free energy function, $(F°-H°_0)/T$; the entropy, $S°$; the heat content, $H°-H°_0$; the heat capacity, $C_p°$; the heat of formation from the elements, $\Delta Hf°$; the free energy of formation from the elements, $\Delta Ff°$; and the logarithm of the equilibrium constant of formation from the elements, $\log_{10} Kf$. Equilibrium constants and concentrations of components are given in tabular and graphical form for the isomerization of the two butynes and of the three pentynes as a function of temperature to 1,500°K. Equilibrium constants are also given in tabular and graphical form for the dehydrogenation of ethane to ethylene to acetylene, of propane to propylene to propyne, of n-butane to 1-butene to 1-butyne, and of n-pentane to 1-pentene to 1-pentyne.

--Author's Abstract

BUTENES, ISOMERIZATION EQUILIBRIA

Voge, H.H. and May, N.C. ISOMERIZATION EQUILIBRIA AMONG THE n-BUTENES. *J. Am. Chem. Soc.* 68, 550-553 *(1946) April.*

Isomerization equilibria among the three n-butenes have been measured in the vapor phase at 200 to 630°. Trans-2-butene is the most stable isomer at the lower temperature, but 1-butene and cis-2-butene are nearly as stable at the higher temperature. Equilibrium constants and free energy changes for the isomerization reactions are given. The results are compared with thermochemical measurements and with data derived from the third law of thermodynamics and spectroscopic observations.

--Author's Summary

CATALYSIS

Selwood, P.W. MAGNETISM AND CATALYSIS. *Chemical Reviews* 38, 41-77 *(1946) February.*

The possibility of relationships between catalytic activity on the one hand, and magnetic fields and magnetic properties on the other, has interested many workers. It cannot be denied that those chemical elements which show the most pronounced catalytic activity, namely, the transition group elements, are also the elements which show the most interesting magnetic properties. In at least one case, the ortho-para hydrogen conversion, there is a clear-cut relationship between magnetic moment and catalytic activity. This is not to say that all catalytic activity is due to magnetism. It may yet appear that catalysis and magnetism are different manifestations of some more fundamental atomic property. But for the present, the chief applications of magnetism to catalysis are in structural studies of catalytic solids. A review of

such applications, and of certain related effects, is the purpose of this article. Susceptibility data are included for some substances of major catalytic interest.

—Author's Abstract

CATALYSTS

Riesz, C.H., Lister, F. and Komarewsky, V.I. CATALYSTS FOR HYDROCARBON SYNTHESIS. *Abstracts 109th Meeting Am. Chem. Soc. April, 1946, p. 5G.*

Up to the present catalysts for the synthesis of liquid hydrocarbons from carbon monoxide and hydrogen have contained three or more components. The function of the various constituents of these complicated catalysts has never been clearly elucidated. It has been proposed that the synthesis catalyst is in reality a "complex-action" catalyst which provides a surface-combining hydrogenating ability for reduction of carbon monoxide to methylene and polymerizing ability for combination of methylene groups into higher hydrocarbons. While other factors enter into the reaction mechanism, the explanation of the role of the catalyst have been substantiated by the preparation of active contacts which contain cobalt, nickel, or iron for hydrogenation and silica, alumina, or zinc oxide for control of polymerization. For liquid hydrocarbon formation, cobalt was the most effective hydrogenation ingredient while silica provided a suitable degree of polymerization; a cobalt-silica (75:25 weight ratio) was found to be as active as a standard cobalt-thoria-kieselguhr catalyst. Nickel and iron were less satisfactory as hydrogenating components in the synthesis of hydrocarbon oils. Alumina and zinc oxide, especially the latter, were more active in promoting the formation of gaseous products.

—Author's Abstract

FISCHER-TROPSCH CATALYSTS

Hofer, L.J.E., Peebles, W.C. and Dieter, W.E. MAGNETIC AND X-RAY DIFFRACTION STUDIES OF UNREDUCED FERRIC OXIDE FISCHER-TROPSCH CATALYSTS. *Abstracts 109th Meeting Am. Chem. Soc. April, 1946, p. 4G.*

Catalysts prepared by precipitation with potassium carbonate or hydroxide from a solution of a ferric salt are inactive in the Fischer-Tropsch synthesis if the original solution contains chloride anion and active if the original solution contains nitrate ion only. This difference in activity is an extremely marked one; the catalysts precipitated in the presence of chloride ion in one case produced no more than 2 or 3 grams of liquid hydrocarbons per cubic meter of synthesis gas while catalysts precipated in the presence of nitrate ion, in some cases, gave yields as high as 70 grams of liquid hydrocarbons per cubic meter of synthesis gas.

—Excerpt from Author's Abstract

HYDROCARBON - SULFUR REACTIONS

Rasmussen, H.E., Hansford, R.C. and Sachanen, A.N. REACTIONS OF ALIPHATIC HYDROCARBONS WITH SULFUR. *Ind. Eng. Chem. 38, 376-382 (1946) April.*

A process is described for reacting aliphatic hydrocarbons, containing at least four carbon atoms in a straight chain, with sulfur to give the corresponding olefin, diolefin, and thiophene or thiophene homolog. If

the charge stock is commercial (95%) n-butane, the following variations of the process are possible; (a) an 80% conversion to a product consisting of 35% thiophene, 35% butadiene, and 30% n-butylene by weight by recycling unreacted butane; (b) a 75% conversion to equal weights of thiophene and butadiene by recycling unreacted butane and butylene; or (c) a 50% conversion to thiophene alone by recycling unreacted butane, butylene, and butadiene.

--Author's Abstract

HYDROGEN - HYDROCARBON VAPOR-LIQUID EQUILIBRIA

Dean, M.R. and Tooke, J.W. VAPOR-LIQUID EQUILIBRIA IN THREE HYDROGEN PARAFFIN SYSTEMS. *Ind. Eng. Chem.* 38, 389-397 (1946) April.

The solubilities of hydrogen in isobutane were determined for temperatures from 100° to 250° F. and pressures from 500 to 3000 pounds per square inch. Solubilities in 2,2,4-trimethylpentane were found for temperatures from 100° to 302.5° and in a mixture of isomeric dodecanes from 200° and 300° F. with pressures ranging from 500 to 5000 pounds per square inch. The compositions of the equilibrium vapor phases were also determined. The solubility of hydrogen increases with temperature and pressure but decreases as the solvent molecular weight increases. The solubility of hydrogen follows Henry's law only in isobutane at 150° F. and lower. The hydrogen solubilities in the two heavier hydrocarbons increase more rapidly with pressure at low pressures than at high pressures. Correlation with literature data shows that hydrogen is more soluble in paraffins than in aromatics of similar molecular weight. Vaporization equilibrium constants are computed from the data for both solvent and solute. The constants vary widely with pressure and to a lesser extent with temperature. The constant for hydrogen increases with an increase in solvent molecular weight.

--Author's Abstract

ISOMERIZATION

Pines, H. and Wackher, R,C. ISOMERIZATION OF ALKANES. I. EFFECT OF OLEFINS UPON THE ISOMERIZATION OF n-BUTANE IN THE PRESENCE OF ALUMINUM HALIDE-HYDROGEN HALIDE CATALYST. *J. Amer. Chem. Soc.* 68, 595-599 (1946) April.

The isomerization of n-butane in the presence of aluminum chloride-hydrogen chloride and aluminum bromide-hydrogen bromide catalyst has been studied using high vacuum technique. It was found that under certain conditions paraffinic hydrocarbons do not undergo isomerization by means of aluminum halide-hydrogen halide catalyst unless olefins are present or probably formed in situ. It was assumed that the olefins function as a source of carbonium ion. The addition of one part of olefin per ten thousand parts of n-butane is sufficient to promote isomerization. The effect of olefins, temperature, and concentration of hydrogen chloride upon the degree of isomerization is given.

--Author's Summary

9. ORGANIC CHEMISTRY

ISOMERIZATION

Pines, H. and Wackher, R.C. ISOMERIZATION OF ALKANES. II. EFFECT OF OXYGEN UPON THE ISOMERIZATION OF n-BUTANE AND n-PENTANE IN THE PRESENCE OF ALUMINUM BROMIDE AND ALUMINUM CHLORIDE. *J. Amer. Chem. Soc.* 68, 599-605 (1946) April.

The effect of oxygen upon the isomerization of n-butane and n-pentane in the presence of aluminum chloride or aluminum bromide has been studied. It was found that the addition of 0.007 mole per cent oxygen, in the form of air, to n-pentane is sufficient to convert 40% of the n-pentane to butanes and isopentane using aluminum chloride catalyst; in the absence of oxygen the reaction does not proceed. The catalytic effect of an aluminum bromide-oxygen-hydrocarbon complex formed by the action of air upon the solution of aluminum bromide in n-butane was studied. The action of oxygen upon aluminum bromide was investigated. The effect of ethylaluminum dibromide and of diethylaluminum bromide in the presence and in the absence of air upon the isomerization of n-butane was investigated. The mechanism of isomerization was discussed.

--Author's Summary

ORGANIC ACID SYNTHESIS

Franke, N.W. and Kiebler, M.W. ORGANIC ACIDS BY DIRECT OXIDATION OF COAL. *Chemical Industries* 58, 580-581 (1946) April.

A process to produce aromatic polycarboxylic acids by the direct oxidation of coal has been developed and is operating on a pilot plant scale. All of the reactants employed are cheap and readily available and every step in the process is apparently applicable to large scale continuous production. The product, a light colored powder, is a mixture of aromatic acids, which are water-soluble and strongly acidic. They undergo the usual reactions characteristic of the carboxyl group and have, in addition, the properties peculiar to polycarboxylic acids. Many uses in fields such as general chemicals, plastics, plasticizers and starting materials for synthesis will undoubtedly be found for this entirely new product.

--Summary

VAPOR PRESSURE OF ORGANIC COMPOUNDS

Berl, E. CHART AND TABLES FOR VAPOR PRESSURES OF ORGANICS ABOVE 1 ATMOSPHERE. *Chem. & Met. Eng.* 53, 122-124 (1946) March.

In a recent issue (Chem. & Met. January 1946, p. 130) the author presented two charts and several tables dealing with the vapor pressures (above 1 atm.) and the corresponding boiling temperatures of 48 elements and inorganic compounds. The present article similarly treats 76 organic compounds. Table 1 lists vapor pressures and corresponding temperatures for the terminal conditions of all compounds in the table.

--Excerpt from article

10. CHEMICAL ENGINEERING

HYDROCARBON THERMODYNAMICS

Edmister, W.C. HYDROCARBON THERMODYNAMICS. *Petroleum Engr.* 17, 130-142 *(1946) April.*

This is the second in a series of articles on this subject. The material is like that previously given in the California Oil World (1945). Several interesting correlations for the prediction of phase equilibria in hydrocarbon systems are given. A chart for heat capacities of many hydrocarbons is included. A plot correlating the values of Cp/Cv for several hydrocarbons in terms of the reduced temperature and pressure is presented for use in compresser calculations. A method of calculating the effect of temperature on latent heat of vaporization is explained.

—J.D. Parent

METERING FACTORS

Weeks, R.W. ORIFICE METER IN NATURAL GASOLINE MEASUREMENT. *Petroleum Refiner* 25, 135-139 *(1946) April.*

The author presents tables of metering factors specifically for natural gasoline flow measurement with orifice meters. The data apply only when the meter runs have been properly constructed and when the line static pressure is at least 1.5 times the vapor pressure of the flowing liquid. Tables are for basic orifice factors using flange tops, where orifice diameter and pipe size are variables, and for specific gravity factors.

—J.D. Parent

ORIFICE METER COEFFICIENTS

Beach, F.K. EFFECT OF HYDROGEN SULPHIDE ON COEFFICIENT FOR ORIFICE GAS METERS. *Petroleum Engr.* 17, 230-238 *(1946) March.*

Calculations are made for gases with 8% H_2S which indicate that the specific gravity is a sufficient criterion for evaluating orifice meter supercompressibility factors for Turner Valley gas. Other calculations are made which indicate that the orifice meter supercompressibility factors based on California Natural Gasoline Association data are in good agreement with the values which would be predicted from the work of Drs. G.G. Brown and D.L. Katz.

—J.D. Parent

PRESSURE VESSELS

Bee, C.F. SIMPLIFIED METHODS FOR CALCULATING STRESSES IN PRESSURE VESSELS. *Chem. & Met. Eng.* 53, 114-116 *(1946) March.*

There are various formulas by which the designers of a pressure vessel—cylindrical or spherical, internal or external pressure—can compute its required thickness. These formulas, however, give widely varying results and comparison is not easy because of their complexity. What the author has done is to convert them to a common comparable basis by means of which the degree of conservatism of the design can be gaged almost at sight. The several formulas are rearranged algebraically to the form

$\frac{P}{S} = 2K \frac{t}{D}$ where the differences between the different formulas are represented by the term 2K and its value becomes a measure (inverse) of conservation.* Numerical values of 2K have been computed and plotted as a function of $\frac{t}{D}$. Use of the graphs makes it possible to tell by inspection how conservative or risky a given theory may be as compared to the other theories.

*Other symbols are as follows: P = Pressure; S = wall stress; t = wall thickness, D = outside diameter.

--J. First

VAPOR PRESSURE AND LATENT HEAT DATA

Seglin, L. CORRELATING VAPOR PRESSURE AND LATENT HEAT DATA. *Ind. Eng. Chem.* 38, 402-405 (1946) April.

The method employed is similar to those proposed by Othmer, and Gorden. The Clapeyron equation is integrated assuming the latent heat to be constant and the resulting equation is put into reduced form. The upper limit of the integrand is the critical temperature, so as to simplify the expression. Reduced pressures for the reference and related substances are equated to get a single equation interrelating the latent heats, reduced temperatures and critical temperatures of the substances being compared. Certain properties of the related substance whose vapor pressure or latent heat is to be evaluated at some selected temperature must be known: These are the critical temperature, critical pressure and the vapor pressure at some temperature. With the substances studied it was possible to predict vapor pressures within 4%, saturation temperatures within 1/2% and latent heats within 5%.

--J.D. Parent

VISCOSITY MEASUREMENTS

Beal, C. THE VISCOSITY OF AIR, WATER, NATURAL GAS, CRUDE OIL AND ITS ASSOCIATED GASES AT OIL FIELD TEMPERATURES AND PRESSURES. *California Oil World* 39, 3-15 (1946) March.

The paper presents useful charts for conversion of various viscosimeter units into centipoise and graphically summarizes published investigations of the viscosity of air, water and natural gas at high temperatures and pressures. Air, water and natural gas are considered because they are produced with, or used to produce, crude oil. All terms in the report are converted to units used commonly in oil field work. Where possible, charts and correlations were constructed to cover a range of temperature (60°F. -300°F.) and pressure (14.7 psia-8,000 psig) encountered in oil fields.

--Author's Abstract

PERIODICALS ABSTRACTED FOR GAS ABSTRACTS

AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE BULLETIN

AMERICAN GAS ASSOCIATION MONTHLY

AMERICAN GAS JOURNAL

AMERICAN PETROLEUM INSTITUTE QUARTERLY

AMERICAN SOCIETY FOR TESTING MATERIALS BULLETIN

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BLAST FURNACE AND STEEL PLANT

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BULLETIN AMERICAN CERAMIC SOCIETY

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CANADIAN JOURNAL OF RESEARCH: SECTIONS A AND B.

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CHEMICAL ABSTRACTS

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ENGINEERS' DIGEST

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INDUSTRIAL AND ENGINEERING CHEMISTRY: INDUSTRIAL EDITION

INDUSTRIAL BULLETIN OF ARTHUR D. LITTLE, INC.

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JOURNAL OF APPLIED MECHANICS

JOURNAL OF APPLIED PHYSICS

JOURNAL OF CHEMICAL EDUCATION

JOURNAL OF CHEMICAL PHYSICS

JOURNAL OF CHEMICAL SOCIETY (LONDON)

JOURNAL OF THE INSTITUTE OF FUEL

JOURNAL OF THE INSTITUTE OF PETROLEUM

JOURNAL OF ORGANIC CHEMISTRY

JOURNAL OF PHYSICAL CHEMISTRY

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TRANSACTIONS ELECTROCHEMICAL SOCIETY
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WEEKLY ANTHRACITE COKE REPORT
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